ARMD Seedling Technical Seminar

Controls and Decision Support Tools for Aviation

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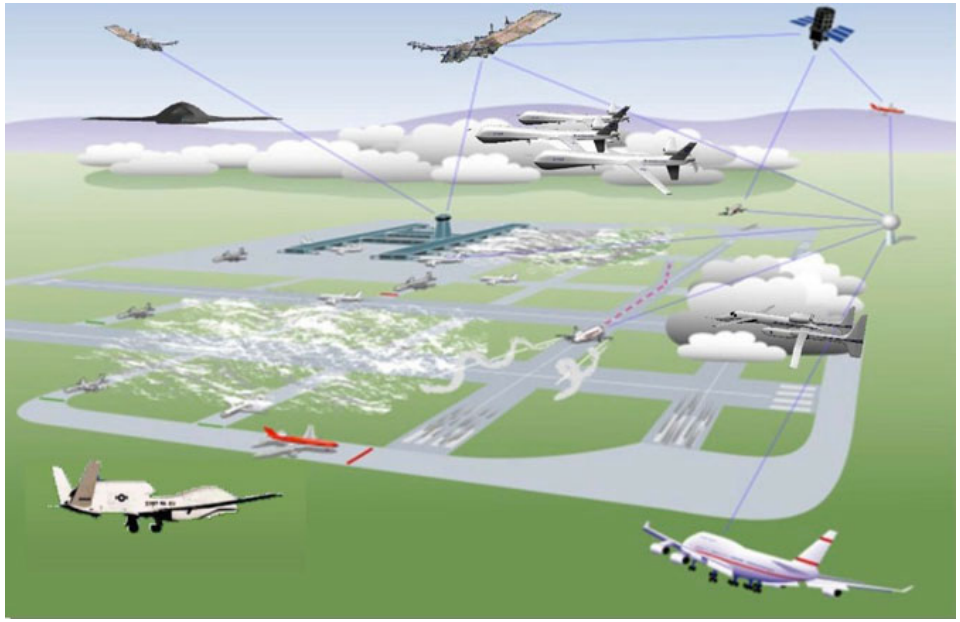
Controls and Decision Support Roles

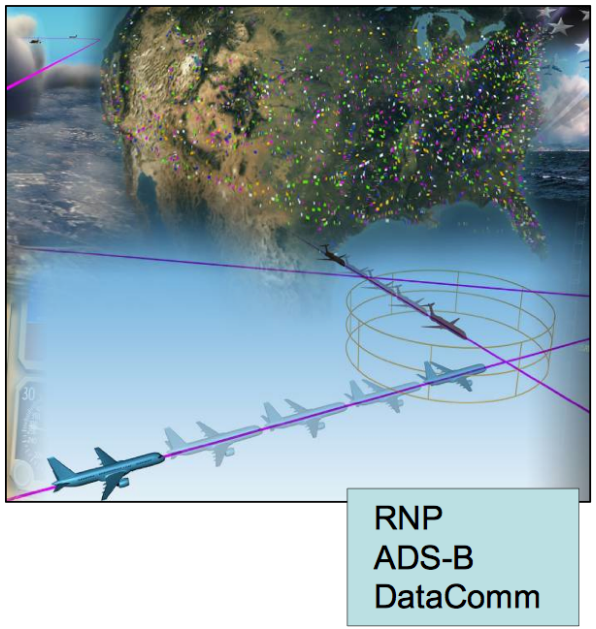
- **Controls and decision support provide critical functionality to aviation operation**
  - Low-level flight control and guidance systems
  - Advisory services to air traffic control via decision support tools
  - Flight-deck technologies for safe and efficient operations

- **Increased complexity in future aviation systems will require tighter integration of controls and decision support tools into aviation systems to enable new advanced capabilities**
  - NextGen
  - Integration of UAS into the NAS
  - Advanced next-generation aircraft concepts
  - Autonomy in aviation

NextGen



NextGen

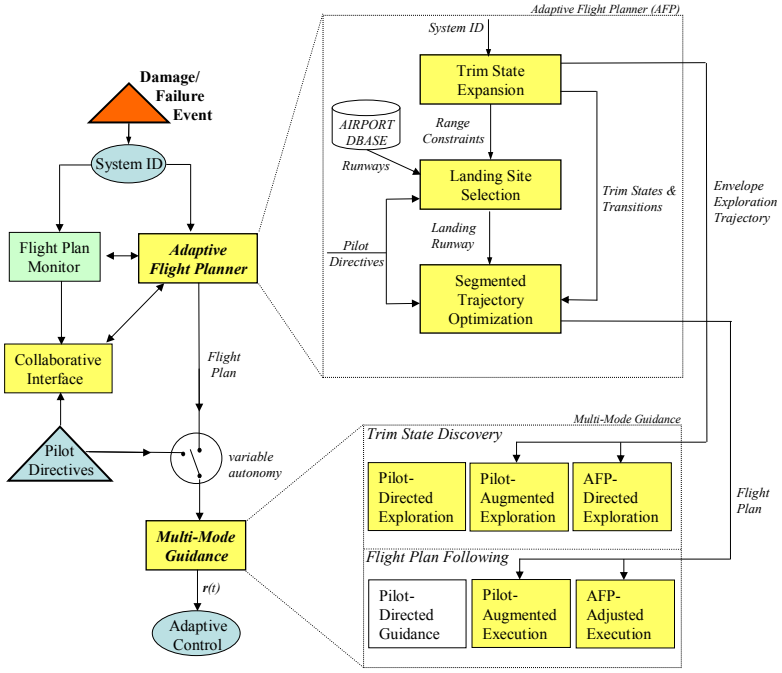


Trajectory-Based Operations

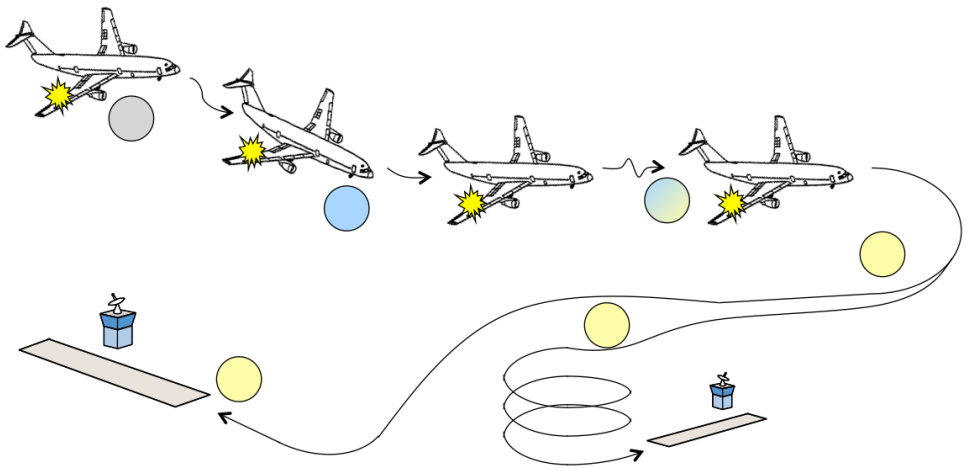
- **Increased air traffic density and trajectory-based operations will require more advanced guidance, control, and navigation (GNC) and decision support**
  - 4D trajectory dynamic flight planning
  - Safe separation assurance
  - Flight path prediction for TCAS
  - Strategic and tactical FMS

Example – Dynamic Flight Planning

- **Provides capability to re-plan trajectories in NextGen or for emergency situations**
  - Adaptive control and guidance with pilot-decision support for flight planning via strategic or tactical FMS



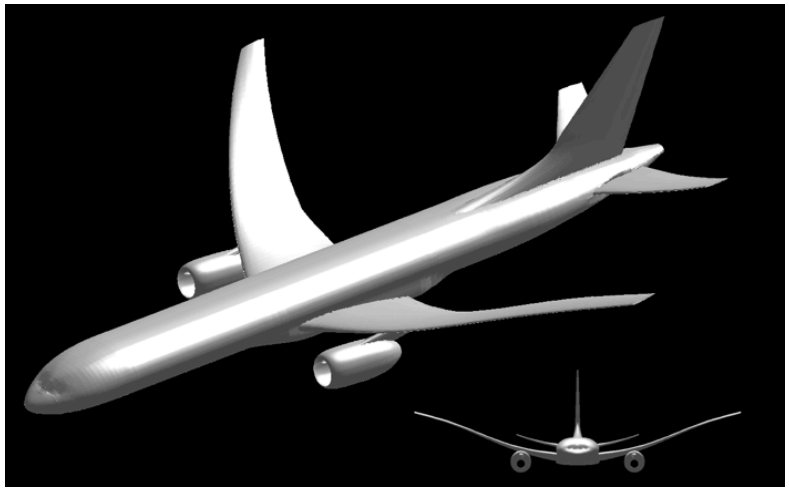
Adaptive Flight Planner – University of Michigan
NASA IRAC Project



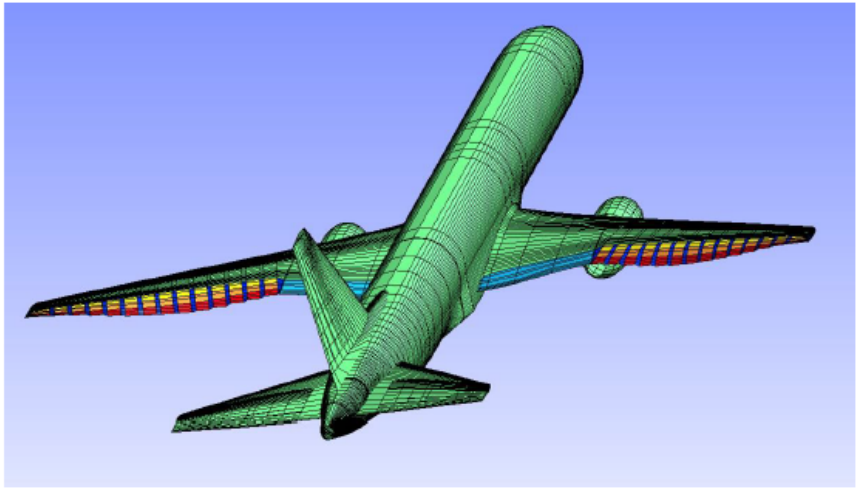
Emergency Flight Planning
NASA IRAC Project

Advanced Next Generation Aircraft

- **Next-generation N+3 advanced aircraft will require increased level of controls and decision support for improved performance for fuel efficiency, and reduced noise and emissions**
  - Real-time adaptive drag minimization flight planning
  - Gust and maneuver load alleviation
  - Aeroelastic mode suppression control
  - Distributed propulsion flight control
  - Noise abatement trajectory optimization



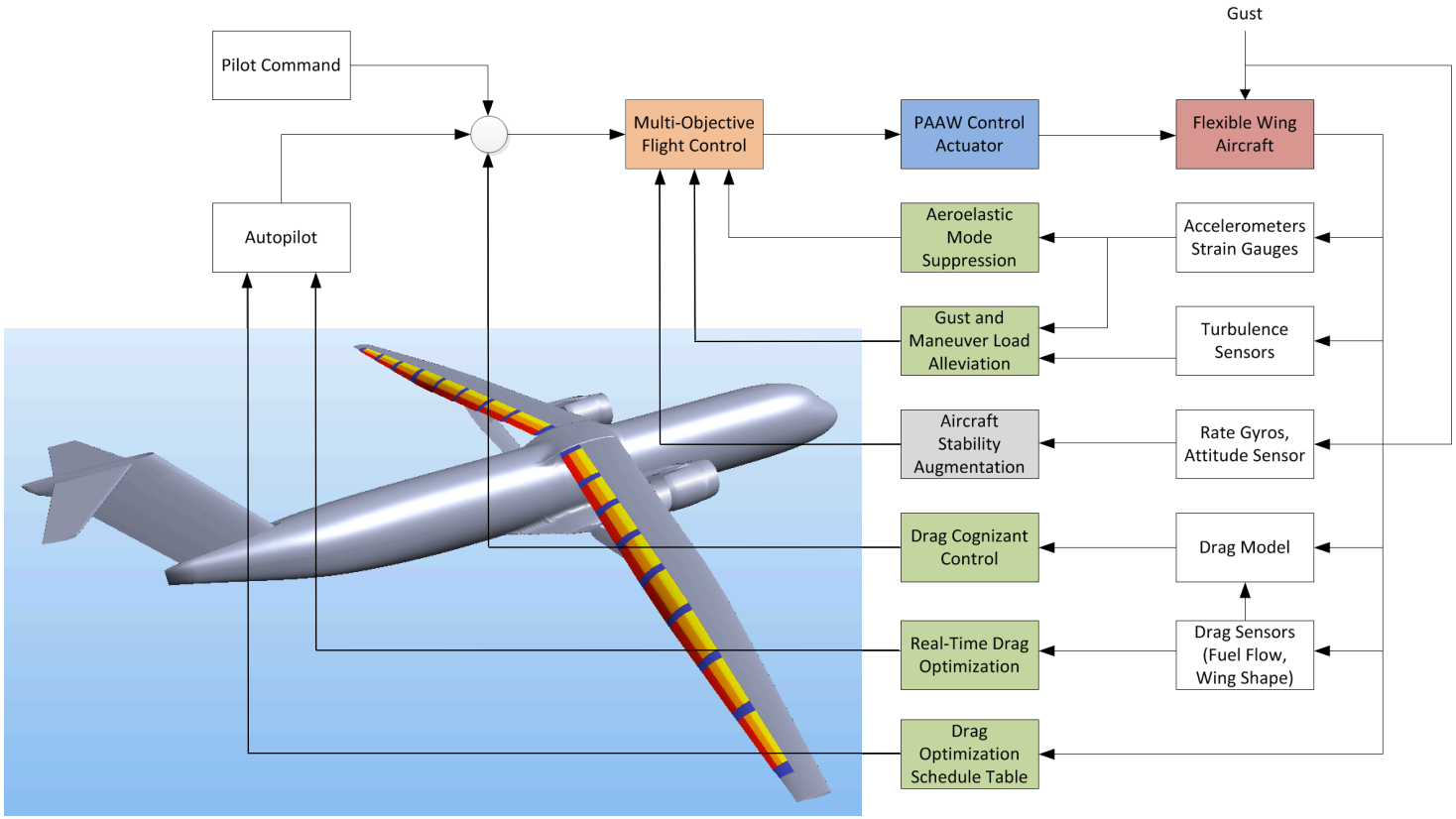
High-Aspect Ratio Flexible Wing Aircraft



Mission-Adaptive Wing Shaping Control
NASA AATT Project

Example – Multi-Objective Flight Control

- **Multi-objective flight control and guidance for high-aspect ratio flexible wing aircraft**

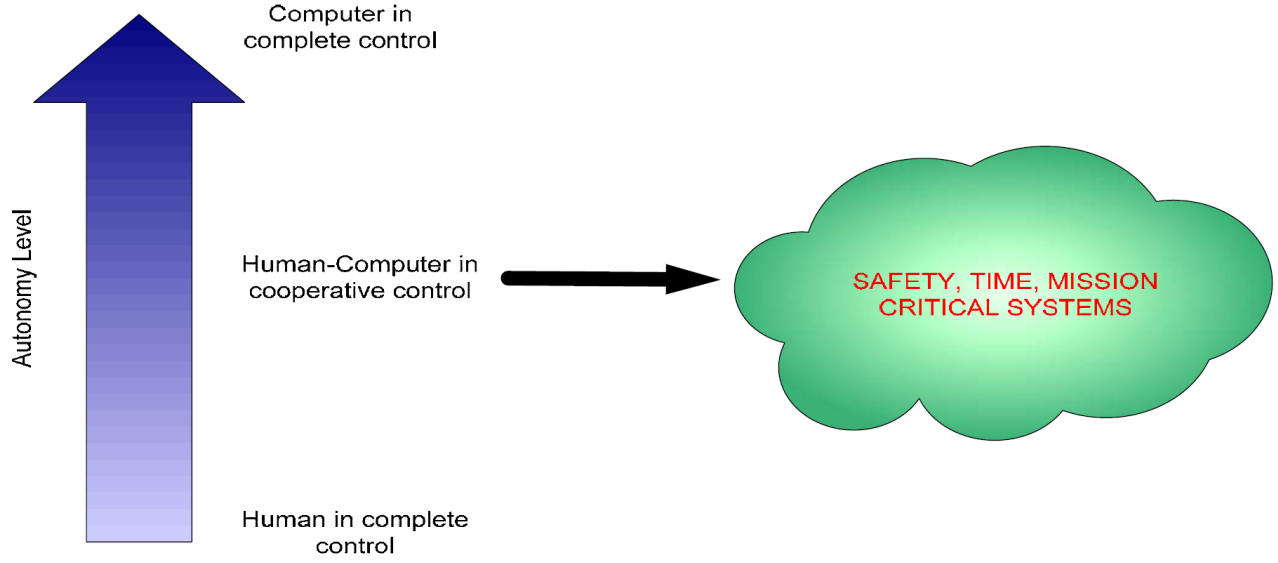


Multi-Objective Flight Control for Performance Adaptive Aeroelastic Wing
NASA AATT Project

Increased Capabilities by Autonomy

- **Future aviation systems will be more complex and have more advanced capabilities and new functionality**

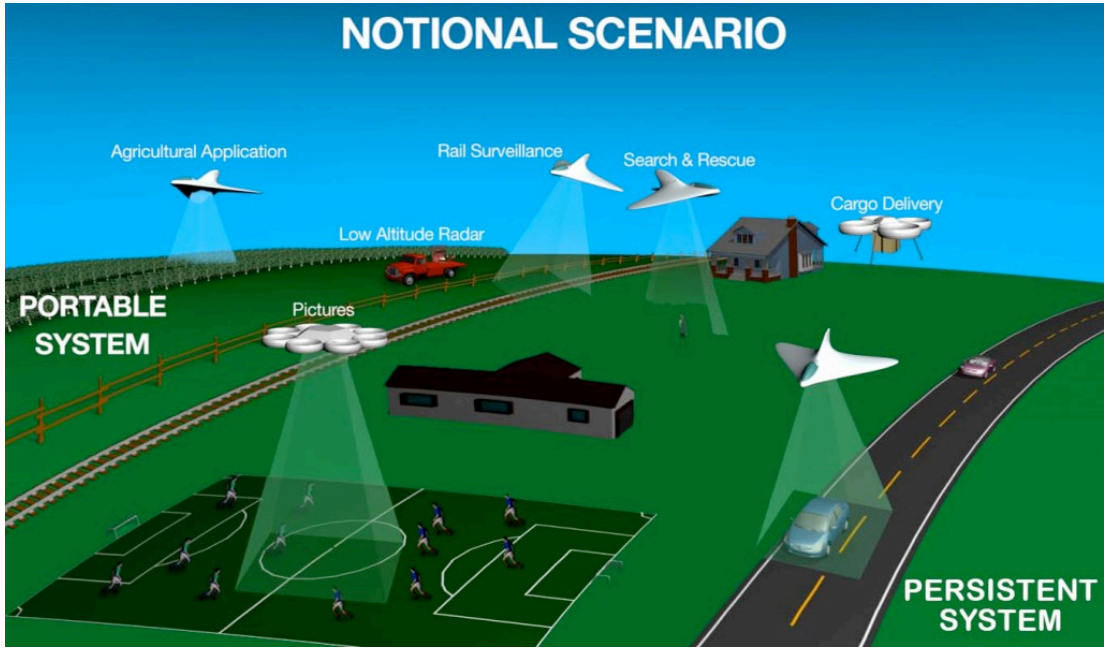
- **Autonomy can enable increased capabilities and new functionality**



- **Autonomy can play many key roles in**
  - NextGen
  - UAS operation and integration into the NAS
  - Vehicle-level performance-based and safety-enhancement aircraft technologies

Example – UAS Operation

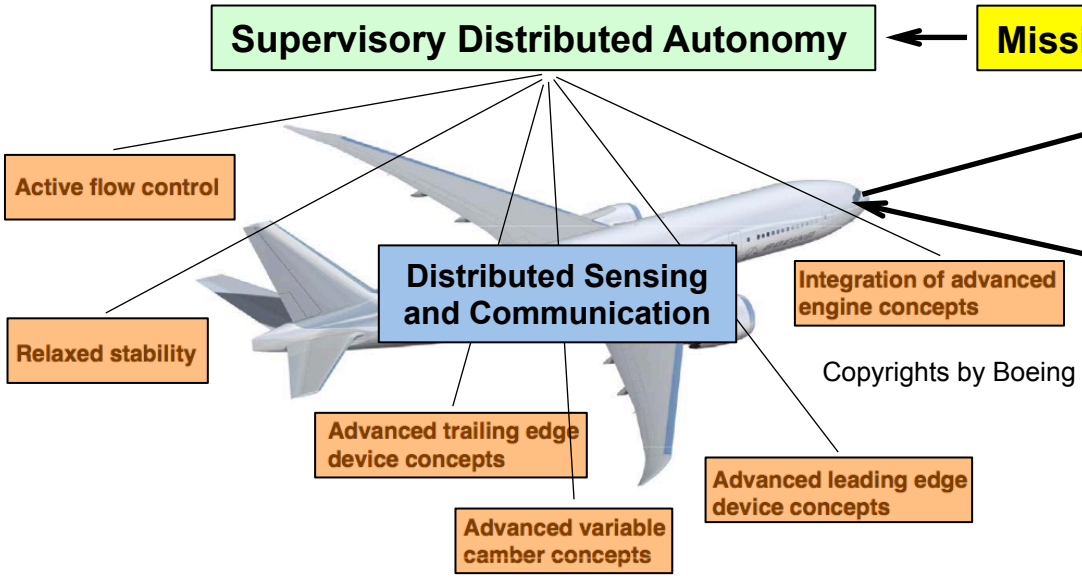
- **Autonomy of UAS requires advanced controls and decision support tools**
  - Vision-based navigation
  - Sense-and-avoid
  - Payload-directed flight



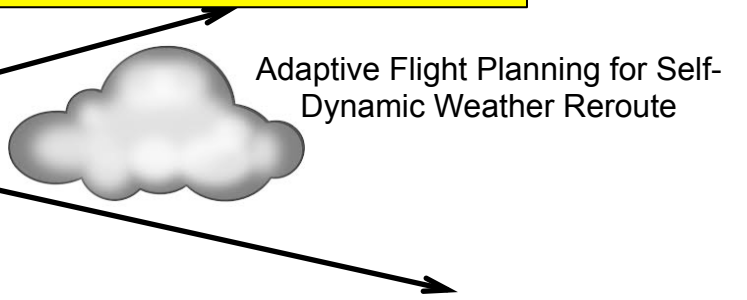
UAS Traffic Management (UTM)
NASA SASO Project

Example – Vehicle Autonomy

- **Vehicle-level autonomy requires multidisciplinary control and decision support that are tightly integrated with vehicle advanced capabilities**



Vehicle-Level Performance-Based Autonomy for Mission-Adaptive Performance



Air Traffic Control